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(54) [Title of the Invention] Printer and print instruction apparatus

(57) [Summary]

[Object] A printer having the function of expressing gradation based on a dot arrangement having a screen angle, wherein print output with the desired screen angle may be obtained using any application that generates and outputs print data.

[Means] Where the paper is set in a designated orientation (landscape orientation, for example) and screen angle adjustment is instructed, the screen angle is moved by a certain amount (such as 90°, for example). Therefore, when performing printing based on print data generated on the assumption that the paper is set in an orientation (portrait orientation, for example) different from the designated orientation while the paper is set in the designated orientation, the print data is not changed in any way.

[Claims]

[Claim 1] A printer capable of expressing gradation by printing a dot arrangement pattern having a screen angle on a sheet of paper, said printer including determination means that determines the orientation of the paper set in the printer, an instruction means that instructs screen angle adjustment, and screen angle adjustment means that changes the screen angle when said determination means determines that the paper is set in the designated orientation and said instruction means instructs screen angle adjustment.

[Claim 2] The printer according to Claim 1, wherein said printer further includes input means that can input print data, and said instruction means instructs screen angle adjustment in accordance with a command included in the data input by said input means.

[Claim 3] A print instruction apparatus that instructs the printer according to Claim 2 to perform printing, said apparatus including conversion means that converts the image information to be printed into commands that can be understood by the printer, generation means that generates a command that instructs screen angle adjustment, and output means that outputs to the printer the command generated by said generation means and the commands obtained as a result of the conversion by said conversion means.

[Detailed Description of the Invention]

[Technological Field of the Invention] The present invention relates to a printer having the function of expressing gradation via a dot arrangement pattern, and a print instruction apparatus such as a host computer that instructs the printer to perform printing.

[Prior Art] A printer of this type in the conventional art receives commands from a host computer that functions as a print instruction apparatus, and forms an image on a sheet of paper in accordance with the commands thus received. In such a printer, because the number of colors that can be expressed is generally limited (to two colors or eight colors, for example), when a gradation image is to be formed, area gradation modulation is carried out by arranging dots in accordance with a prescribed rule in order to obtain pseudo-lighter colors. When this is done, adjacent dots are often arranged at a certain angle (generally 45°) . This angle is generally called screen angle. In addition, in order to permit easy paper feeding, the paper is often inserted into the printer lengthwise, i.e., in a portrait orientation.

[Problems Addressed by the Invention] Printers developed in recent years are able to perform printing on large-sized paper, and an increasing number of them are able to handle A3-size (JIS standard) paper. When performing printing on A4-size paper using such a printer, the amount of feeding of the paper during printing is reduced and printing time is shortened by using landscape orientation when inserting the paper and forming an image that is rotated 90° from the image used when the regular portrait orientation is used

for paper insertion. In this situation, naturally the screen angle in the image must be changed by 90°. However, some of the existing applications in the host computer that generate the print image do not consider this requirement. Where printing is to be performed using such an application, if the paper supply orientation is landscape orientation, the problem occurs that the screen angle is off by 90° relative to the desired screen angle.

It is also possible to automatically adjust the screen angle on the side of the printer when the paper is supplied in landscape orientation. However, some applications recognize that the paper was supplied via landscape orientation based on the communication of information between the host computer and the printer, and generate an image that has been subjected to automatic screen angle adjustment on the side of the application. In such a case, if the screen angle is automatically adjusted by the printer, that offsets the effect of the processing by the application, and the desired screen angle cannot be obtained. The present invention was created in order to resolve the problems described above, and an object thereof is to provide a printer that has the function of expressing gradation based on the arrangement of dots having a screen angle and an associated print instruction apparatus, wherein print output can be obtained with the desired screen angle regardless of the application that generates and outputs the print data.

[Means to Resolve the Problems] In order to achieve the above object, the invention according to Claim 1 is a printer capable of expressing gradation by printing a dot arrangement pattern having a screen angle on a sheet of paper, such printer including determination means 1 that determines the orientation of the paper set in the printer, an instruction means 2 that instructs screen angle adjustment, and screen angle adjustment means 3 that, when the determination means 1 determines that the paper is set in the designated orientation and the instruction means 2 instructs screen angle adjustment, changes the screen angle, as shown in Fig. 1. The invention according to Claim 2 is the printer according to Claim 1, wherein such printer further includes input means that can input print data, and the instruction means 2 instructs screen angle adjustment in accordance with a command contained in the data input by the input means. The invention according to Claim 3 is a print instruction apparatus 5 that instructs the printer (printing means) 9 according to Claim 2 to perform printing, such apparatus including conversion means 6 that converts the image information to be printed into commands that can be understood by the printer, generation means 7 that generates a command that instructs screen angle adjustment, and output means 8 that outputs to the printer 9 the command generated by the generation means 7 and the commands obtained as a result of the conversion performed by the conversion means 6, as shown in Fig. 2.

[Operation] According to the printer described above, where the paper is set in the designated orientation (landscape orientation, for example) by the determination means 1 and screen angle adjustment is instructed by the instruction means 2, the screen angle adjustment means 3 moves the screen angle by a certain amount (90°, for example). Therefore, where print data that is prepared assuming that the paper is set in an orientation (portrait orientation, for example) different from the designated orientation is to be printed with the paper set in the designated orientation as described above, if screen angle adjustment is instructed by the instruction means 2, the print data is not changed, thereby permitting the desired printing result to be obtained. Furthermore, according to the print instruction apparatus 5, commands obtained as a result of conversion by the conversion means 6, as well as a command generated by the generation means 7, are sent to the printer 9. Therefore, screen angle adjustment may be instructed via the print instruction apparatus 5 that is operated by the operator, without the need to instruct screen angle adjustment on the side of the printer 9, and such instruction may be supplied to the printer 9.

[Embodiments] An embodiment of the present invention is described below with reference to the drawings. Fig. 3 shows the external appearance of a printer main unit 10 comprising a laser printer or the like pertaining to this embodiment. The printer main unit 10 includes multiple (two in the drawing) paper supply cassettes 11 and 12, and a hand insertion tray 13, such that paper up to A3 size may be supplied in portrait orientation. Because the paper supply inlet has a width (297mm) that can accommodate A3-size paper, paper equal to or smaller than A4 size may be supplied in either portrait or landscape orientation. These paper supply cassettes each have an identification index comprising a combination of electrical insulation members and conductive members. The size and orientation of the paper housed in the paper supply cassette can be transmitted to the printer controller via these indices. The printer main unit 10 also includes a paper eject unit 14 that ejects post-printing paper, an operation panel 15 that has the function of setting the type of paper set in the hand insertion tray 13, and other components.

The printer learns the size and orientation of the paper housed in each paper supply source based on the indices thereof as well as via setting using the operation panel 15. A printing unit and fusing unit are disposed in the paper supply path for the paper supplied from each paper supply source. Because the printing unit and fusing unit used here are in the public domain, they are not described in detail herein.

Fig. 4 shows a block diagram of the controller 31 included in the printer main unit 10. The controller 31 constitutes an interface 32 that is disposed between the host computer 20 and the printing unit (engine) 36 that performs operations for printing and

enables communication with the host computer 20, a CPU 33 that executes processing, a ROM 34 in which are stored the interpreter program and the like to execute the commands sent from the host computer 20, and a RAM 35 in which image data is stored, as well as other components.

The interpreter program has the following construction. Character analysis is performed by a character analyzer, such that the character data is broken down into commands and parameters, and sentence analysis is carried out by a sentence analyzer. A search is performed from a table stored in the ROM 34 regarding the character string that indicates the command obtained through the character analysis to obtain the corresponding processing address. For example, in the processing address that corresponds to the command 'setscreen' is stored a program that reads the three parameters (generally stored in a stack) located immediately before the command 'setscreen', and stores the parameters under the descriptions of number of lines, screen angle and dot function in the state setting parameter block. In the processing address that corresponds to the command 'setdoautoangle' is stored a program that reads the parameter ('true' or 'false', generally stored in a stack) located immediately before the command, and if the parameter is 'true', turns ON the screen angle adjustment flag, and if false, turns the flag OFF. The printer driver on the side of the host computer 20 does not have the function of designating the paper orientation, and the desired image is obtained, regardless of the orientation in which the paper was inserted in the printer, via the operations performed on the side of the printer, which is described below.

The host computer will now be explained with reference to Fig. 5. The host computer 20 serves as a print instruction apparatus that instructs the printer main unit 10 to perform printing. The memory (RAM 21) includes memory areas 22, 23 and 24 in which applications, data and printer driver program are stored, respectively. The host computer 20 generates print image data in accordance with control executed by a CPU not shown, and sends it to the printer main unit 10 via the interface 25.

A printer driver startup program is stored in the memory of the host computer 20 at all times. The printer driver comprises a conversion routine in which the image data to be printed is received from the application and converted into commands, subroutines (dictionaries), and an initialization command generator that generates commands for initialization. Because the conversion routine and subroutines are in the public domain, they will not be described in detail herein. The initialization command generator comprises a dialog generator that generates a dialog including a screen angle adjustment switch, and a character string generator that generates corresponding command character strings in response to switches such as that mentioned above.

The operation of the apparatus pertaining to the above embodiment will now be explained with reference to the flow charts of Figs. 6 and 7. When the operator instructs printing via the application running on the host computer 20, the application generates data to be printed in the memory, and transfers control to the printer driver startup program via a software interrupt (trap). The printer driver startup program loads the printer driver from an auxiliary storage device or the like on which such printer driver is installed, and stores it in the memory area 24 of the RAM 21. Control is then transferred to the printer driver. The printer driver first generates and displays a dialog via the dialog generator on the host computer screen, prompting input from the operator (S1). The operator turns ON desired switches (including a screen angle adjustment switch) in the dialog by designating them using a mouse or the like where necessary.

The printer driver performs input and setting processes in response to such operation (S2). When the input process is finished, the operator clicks on the 'OK' button using the mouse. The printer driver monitors for the mouse signal (S2, S3 loop), through which operation the internal screen angle adjustment flag is changed (S4). In other words, where the screen angle adjustment switch is turned ON, the flag becomes ON, and where it is turned OFF, the flag becomes OFF. If no operation takes place, the flag state remains as is (i.e., in the previously set state). After the processing in S4, the printer driver sends the subroutines (dictionaries) to the printer (S5). The printer driver then checks the internal flag state (S5), and where the flag is ON, it generates the character string 1 'truesetdoautoangle', and where the flag is OFF, it generates the character string 2 'false setdoautoangle' (S6, S7, S8), and sends it to the printer (S9). When these processes are finished, the printer driver converts the print data generated in the memory into commands understandable by the printer, and sends them to the printer in sequence (S10, S11). Control is thereafter transferred to the application.

Other examples of the character string (command) generated in the above processing are shown below. Where the screen angle is designated via the application as 45°, the number of screen lines designated as 60 lines, and the dot function designated as 'proc', the character string '60 45 proc setscreen' is generated in the above processing and sent to the printer. Where lighter color having a density of 0.5 is set, the character string '0.5 setgray' is generated and output to the printer. Where printing on A4-size paper is designated, the character string 'a4' is generated and output to the printer.

The processing performed on the side of the printer will now be explained with reference to Fig. 7. The controller 31 of the printer receives the data as character strings from the host computer 20 via the interface 32, and stores it in a buffer memory (S21). After loading the subroutines (S22), the interpreter program reads the initialization

commands. If 'setdoautoangle' appears in the initialization commands (S23), the parameter located before such command is read (S24). If the parameter is 'true', the screen angle adjustment flag is turned ON, and if the parameter is 'false', the screen angle adjustment flag is turned OFF (S25, S26, S27).

Where a paper size setting command (such as 'a4', for example) appears, the interpreter program detects whether paper of that size is housed in any of the two paper supply cassettes 11 and 12 and the hand insertion tray 13, and if it is, designates the paper supply source housing the paper as the operation target and checks the orientation of the paper housed in that paper supply source. Where the paper orientation is landscape (the designated orientation), the internal paper orientation flag is turned ON, and if the paper orientation is portrait, the internal paper orientation flag is turned OFF (S28, S29, S31). Where the paper orientation is landscape, the coordinates are rotated by 90° and moved by a prescribed amount in the x and y directions, whereupon new coordinates are created (S30). For this processing, the routine used when switching between landscape and portrait may be used. Through such coordinate conversion, the same printing is enabled regardless of the orientation in which the paper is supplied.

The AND value of the paper orientation flag and the screen angle adjustment flag is then calculated (S32). If the AND value is OFF, the screen angle in the state setting parameter block is supplied to the image draw routine as is, while if the AND value is ON, a value of the screen angle to which 90° is added is supplied to the image draw routine (S33, S34). In the image draw routine, the image is created in the memory in accordance with the state setting parameter block (S35). The image data created in this way is supplied to the printing unit 36, whereupon the image is printed on the paper.

As is clear from the above discussion, the interpreter program comprises the screen angle adjustment means, and where the orientation of the paper is 'portrait', it sets the screen angle to the prescribed angle regardless of an instruction for screen angle adjustment. On the other hand, if the paper orientation is 'landscape' (the designated orientation), the program operates to change the screen angle by 90° only when an instruction for screen angle adjustment has been issued from the printer driver. The portrait and landscape orientations above are interchangeable. Where a command to return the set screen angle is supported in the interpreter, when that command is called, the screen angle to be returned to must be a screen angle that is obtained by subtracting 90° from the actual screen angle only when screen angle adjustment is instructed by the instruction means and the paper is inserted in landscape orientation.

The effect that is obtained through the above processing will now be explained with reference to Fig. 8. With regard to the image data (the paper supply orientation is

'portrait') having a screen angle shown in Fig. 8(a), the print output when the paper is inserted in portrait orientation acquires the same screen angle as shown in Fig. 8(b). On the other hand, where the paper is inserted in landscape orientation, if the above processing is carried out, screen angle adjustment takes place, and therefore the print output shown in Fig. 8(c) is obtained, which is the same output as that obtained when the paper was inserted in portrait orientation. If the above processing is not carried out, the print output resembles that shown in Fig. 8(d), which has a screen angle offset by 90°.

The present invention is not limited to the embodiment shown above, and may be implemented with various modifications. For example, in order to adjust the screen angle outside the application, two methods are possible: a method to calculate the screen angle and perform adjustment in the printer, and a method wherein adjustment is performed by the driver. For the former method, the instruction for adjustment may be issued by the printer driver as in the embodiment, or by means of a panel switch disposed in the printer.

An example in which the printer main unit has a screen angle adjustment mechanism was shown in connection with the embodiment described above, but it is also possible for the printer driver to have this adjustment mechanism. A first method for obtaining this construction is shown below. When the printer driver is booted, a command that prompts the return of a matrix showing the designated paper size is sent before the subroutines or commands are sent, and the printer driver waits to receive the matrix. When the matrix is received from the printer, the printer driver detects the orientation in which the paper is set by comparing the vertical value and the horizontal value of the matrix. If screen angle adjustment is instructed by the instruction means, the printer driver automatically adjust the screen angle when sending the commands, taking into consideration the paper orientation.

The second method is a method in which the printer driver does not learn the orientation of the paper, and forms a command string to form an appropriate screen angle regardless of the set paper orientation and send it to the printer main unit. In this case, the command string sent to the printer materializes the following algorithm. That is, the orientation of the paper is detected, the issuance of an instruction from the instruction means is determined, and the screen angle is replaced depending on the results of such detection and determination. In this case, the above processing is not carried out on the side of the host computer, but rather on the side of the printer after the command string is sent to the printer. Therefore, the printer driver itself does not need to detect the paper orientation. Therefore, while two-way communication was required in the first method, this method can be implemented based on a one-way interface. Furthermore, in the above embodiment an instruction for screen angle adjustment needed to be issued by the

operator, but it is also possible to have screen angle adjustment performed by the application that called out the printer driver.

[Effect of the Invention] As described above, according to the printer of the present invention, regardless the orientation in which the paper is set, the desired image can be printed without any changes to the image data, particularly to the screen angle. Furthermore, because the print instruction apparatus of the present invention allows the operator to issue an instruction for screen angle adjustment via such apparatus, which is at the operator's fingertips, the operator does is not required to travel to the printer in order to issue the instruction, thereby improving operability.

[Brief Description of the Figures]

[Figure 1] is a block diagram showing the basic construction of a printer pertaining to the present invention;

[Figure 2] is a block diagram showing the basic construction of a print instruction apparatus pertaining to the present invention;

[Figure 3] is a drawing showing the external appearance of the printer comprising an embodiment of the present invention;

[Figure 4] is a block diagram showing the printer controller;

[Figure 5] is a block diagram showing the essential components of the print instruction apparatus;

[Figure 6] is a flow chart showing the operation performed by the printer driver;

[Figure 7] is a flow chart showing the operation performed on the side of the printer; and

[Figure 8] is a drawing by which to explain the effect of the present invention.

[Key]

1 DETERMINATION MEANS

2 INSTRUCTION MEANS

3 SCREEN ANGLE ADJUSTMENT MEANS

5 PRINT INSTRUCTION APPARATUS

6 CONVERSION MEANS

7 GENERATION MEANS

8 OUTPUT MEANS

9 PRINTER (PRINTING MEANS)

10 PRINTER MAIN UNIT